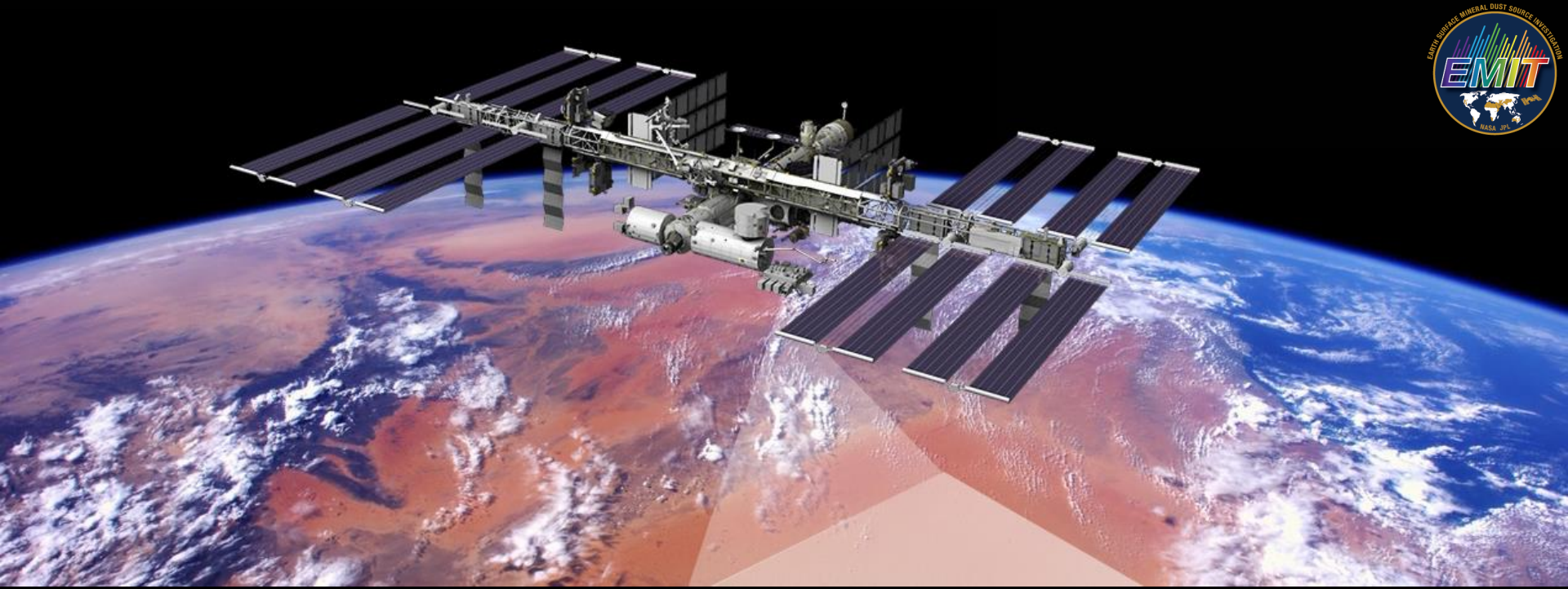


NASA Biodiversity and Ecological Conservation Team Meeting

# EMIT mission introduction, applications

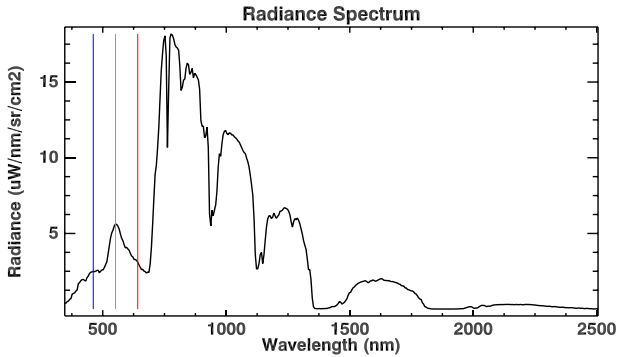
Presented by:
K. Dana Chadwick; Scientist, Water & Ecosystems Group; JPL EMIT Applications Lead

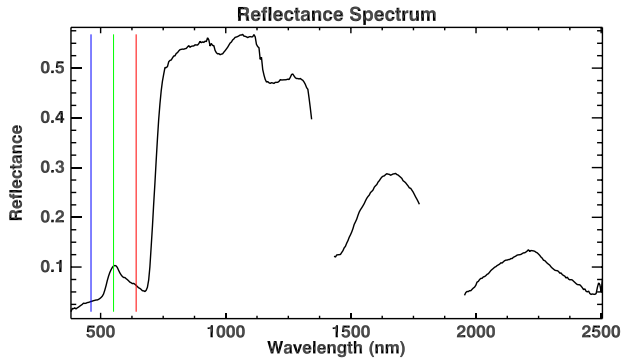


Jet Propulsion Laboratory
California Institute of Technology

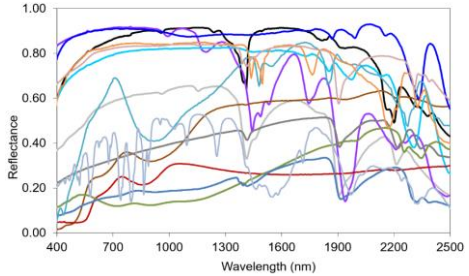
# Visible to shortwave infrared imaging spectroscopy

## Opportunities for Understanding Earth's Surface

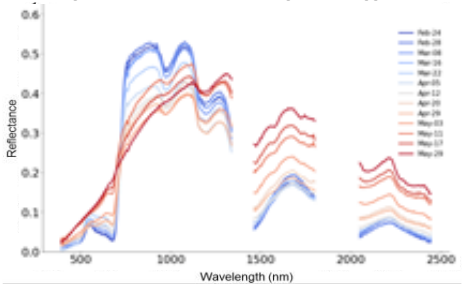


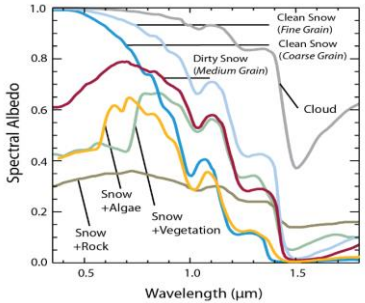

Geology: Mineral Spectral Signatures



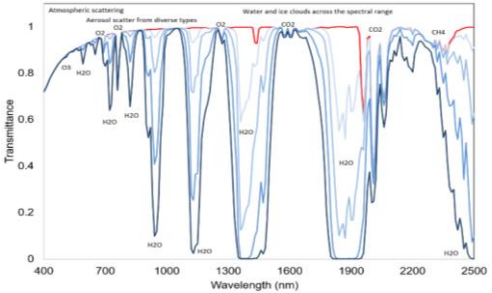

Ecosystems: Diversity of Signatures




Snow/ice: Grain size, Dust, Albedo, Melt




Atmosphere: Gases, Aerosols, Clouds



# Golden age of imaging spectroscopy

## Opportunities for Understanding Earth's Surface


1982 First Imaging Spectrometer (AIS)

AVIRIS

AVIRIS Next Generation

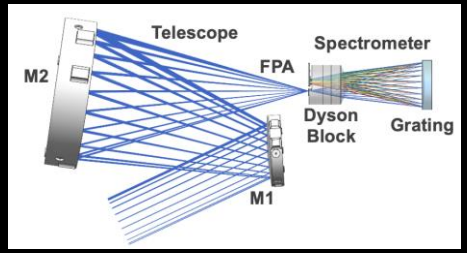
GEO

neon

EMIT

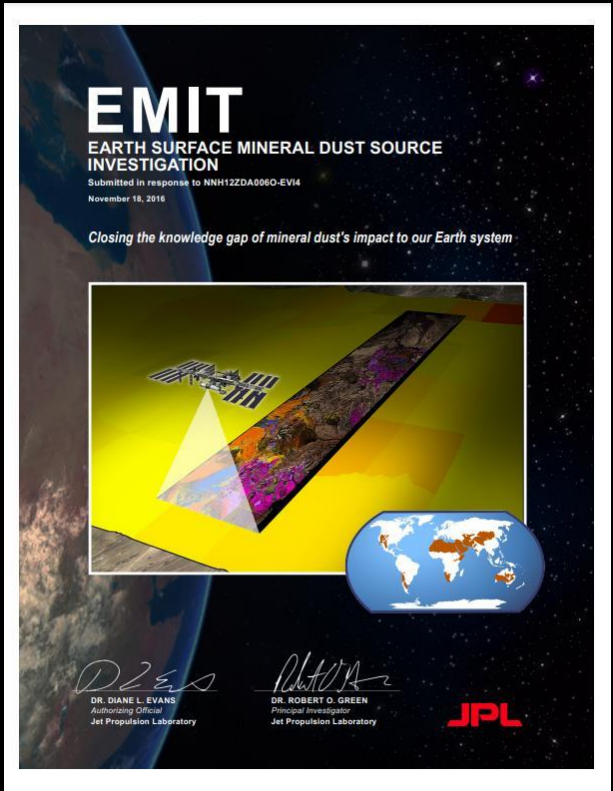
# Golden age of imaging spectroscopy

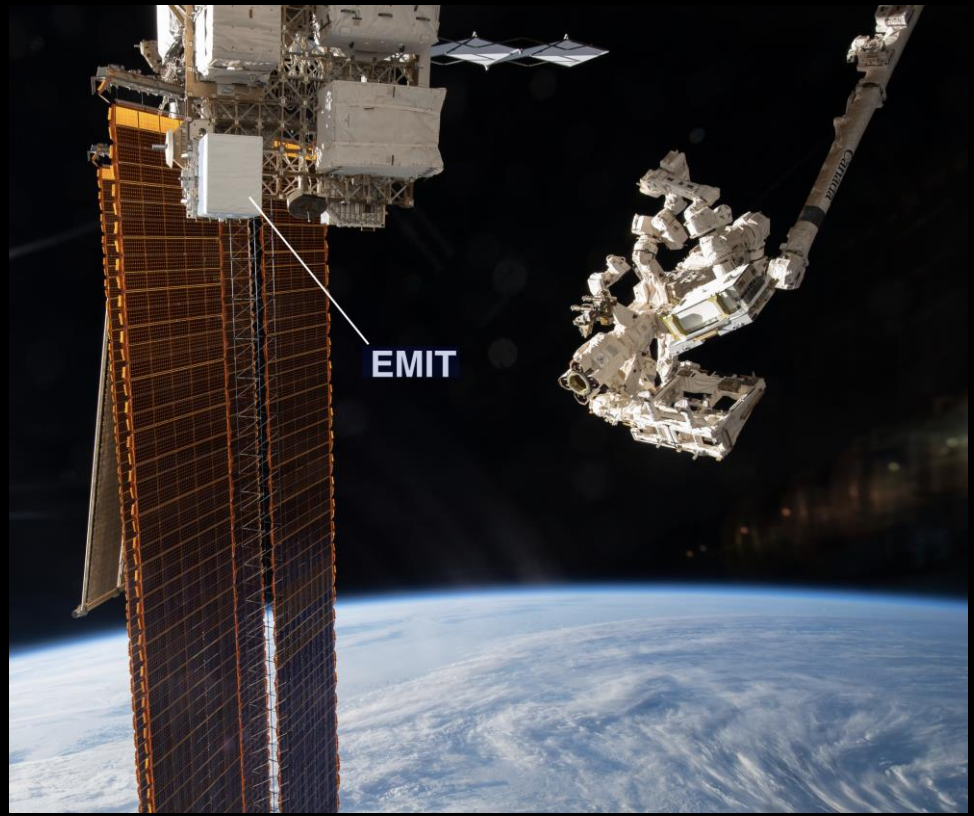
## Opportunities for Understanding Earth's Surface




emit-sds

# Earth surface Mineral dust source InvesTigation



# EMIT Science Team & Project Team

| Investigator | Institution | Role |
|---|---|---|
| Robert O. Green | JPL Caltech | PI |
| Natalie Mahowald | Cornell University | Deputy PI |
| David Thompson | JPL Caltech | Instrument Scientist, Co-I |
| Roger Clark | Planetary Science Institute | Co-I |
| Bethany Ehlmann | JPL Caltech | Co-I |
| Paul Ginoux (CS) | NOAA, Princton University | Co-I |
| Olga Kalashnikova | JPL Caltech | Co-I |
| Ron Miller (CS) | NASA GISS, Columbia University | Co-I |
| Greg Okin | University of California Los Angeles | Co-I |
| Thomas Painter | University of California Los Angeles | Co-I |
| Carlos Perez | NASA GISS, Columbia University (BSC) | Co-I |
| Vincent Realmuto | JPL Caltech | Co-I |
| Gregg Swayze (CS) | US Geological Survey | Co-I |
| | | |
| Elizabeth Middleton (CS) | NASA GSFC | Collaborator |
| Luis Guanter | German Centre for Geosciences (GFZ) | Collaborator |
| Eyal Ben Dor | University of Tel Aviv | Collaborator |

# EMIT Science Team & Affiliates

| Investigator | Institution | Role |
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## Science Affiliates

- **Ray Kokaly** (USGS)
- **María Gonçalves** (BSC)
- **Martina Klose** (BSC)
- **Lauren Zastko** (Cornell)
- **Longlei Li** (Cornell)
- **Vincent Obiso** (GISS)
- **Nimrod Carmon** (JPL)
- **Rebecca Greenberger** (Caltech)
- **Brandon Rasmussen** (Caltech)
- **Philip Brodrick** (JPL)
- **Riley Duren** (U. Arizona)
- **Gregory P. Asner** (Arizona State University)
- **Francisco Ochoa** (UCLA)
- **Daniela Heller Pearlshtien** (Tel Aviv University)
- **Mike Fischella** (UCLA)
- **Dave Connelly** (NYU)
- **Neil Sexton** (Cornell)
- **Yue Huang** (Colombia)
- **Abigail Keebler** (Caltech)
- **Adwoa Aboagye-Okyere** (Cornell)
- **Michael Fischella** (UCLA)
- **Yan Yu** (Princeton)
- **Elisa Bergas** (BSC)
- **Luka Ilic** (FRAGMENT, BSC)
- **Sara Basart** (WMO Dust Prediction Center, BSC)
- **Jesus Yus** (BSC)
- **Cristina Gonzalez** (BSC)
- **Adolfo Gonzalez** (BSC)
- And more

# EMIT Science Objectives

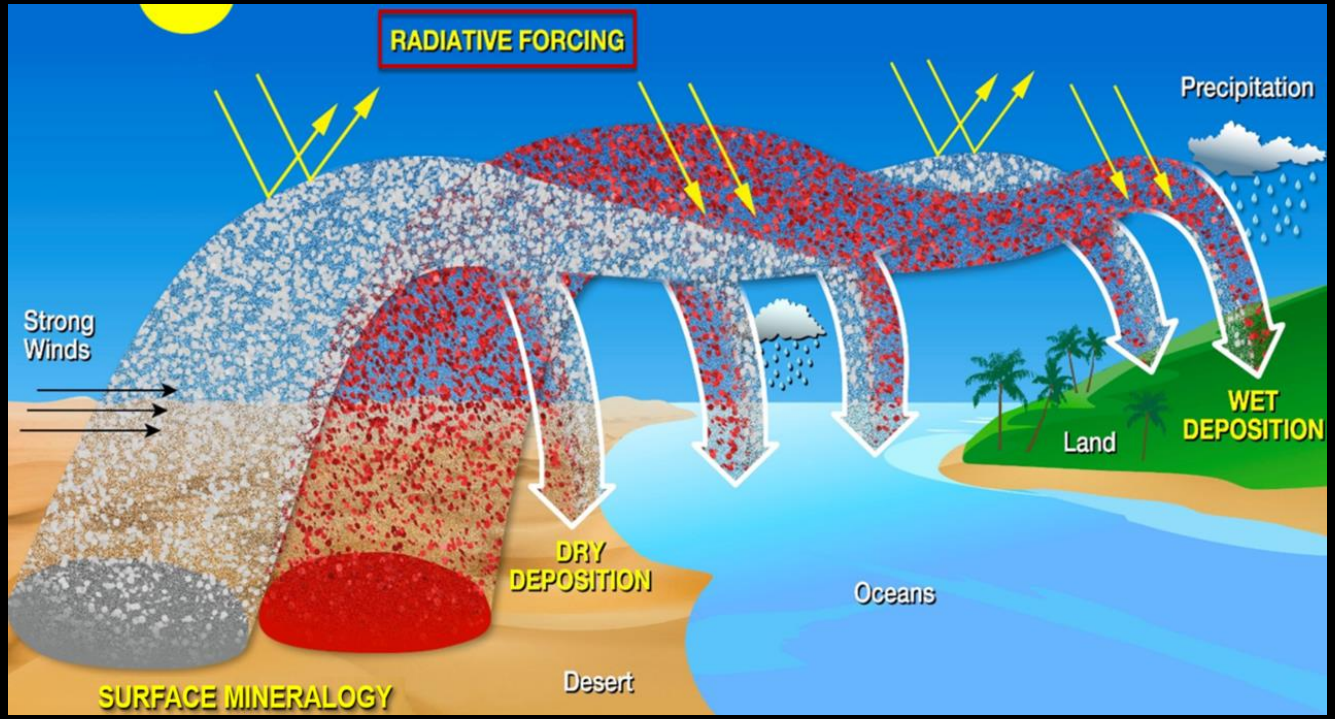
What is the current and future role of mineral dust in atmospheric forcing?


**23 June 2020 African Dust Storm reached the U.S.**

**26 Oct 2007 African Dust Storm seen by MODIS**

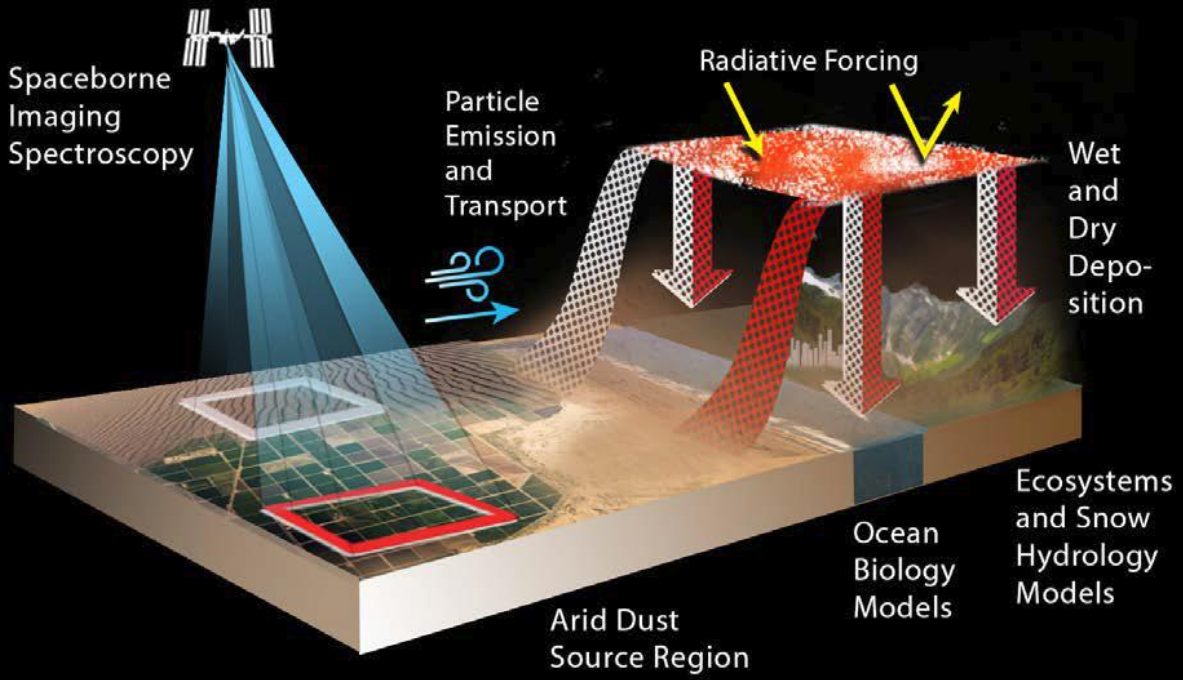
# EMIT Science Objectives

## The role of the mineral dust cycle in radiative forcing



# EMIT Science Objectives & Approach

## Integrating Imaging Spectroscopy and Earth System Modeling

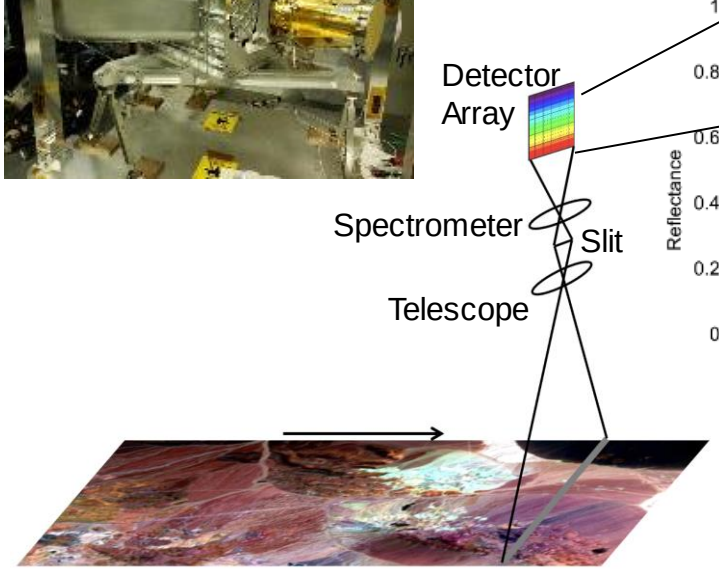



1) Constrain the sign and magnitude of dust-related radiative forcing at regional and global scales by ***acquiring, validating and delivering updates of surface mineralogy*** used to initialize Earth System Models.

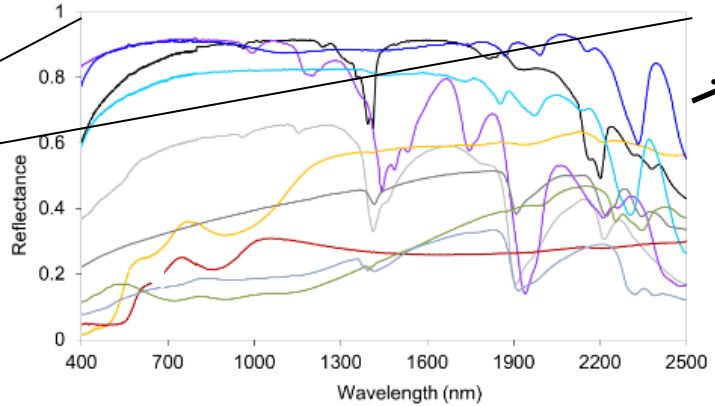
2) Predict the increase or decrease of available dust sources under future climate scenarios objective by ***initializing Earth System Model forecast models with the mineralogy*** of soils exposed within at-risk lands bordering arid dust source regions.

# EMIT Science Approach

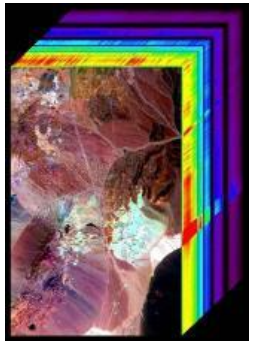
## Imaging spectroscopy to map dust source regions




Mineral Spectral Signatures

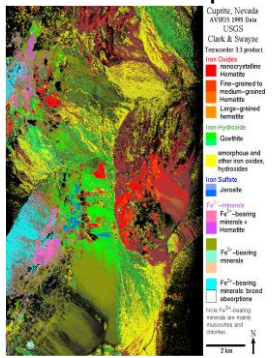



Kaolinite Al4[Si4O10[(OH)8
Montmorillonite (Na,Ca)0.33(Al,Mg)2Si4O10(OH)2*nH2O
Goethite FeO.OH
Gypsum CaSO4.2H2O
Dolomite CaMg(CO3)2
Calcite CaCO3
Illite (K,H3O)(Al,Mg,Fe)2(Si,Al)4O10[(OH
Hematite Fe2O3
Vermiculite (Mg,Fe+2,Al)3(Al,Si)4O10(OH
Chlorite (Mg,Fe)3(Si,Al)4O10(OH)2-(Mg,Fe)3(OH)6



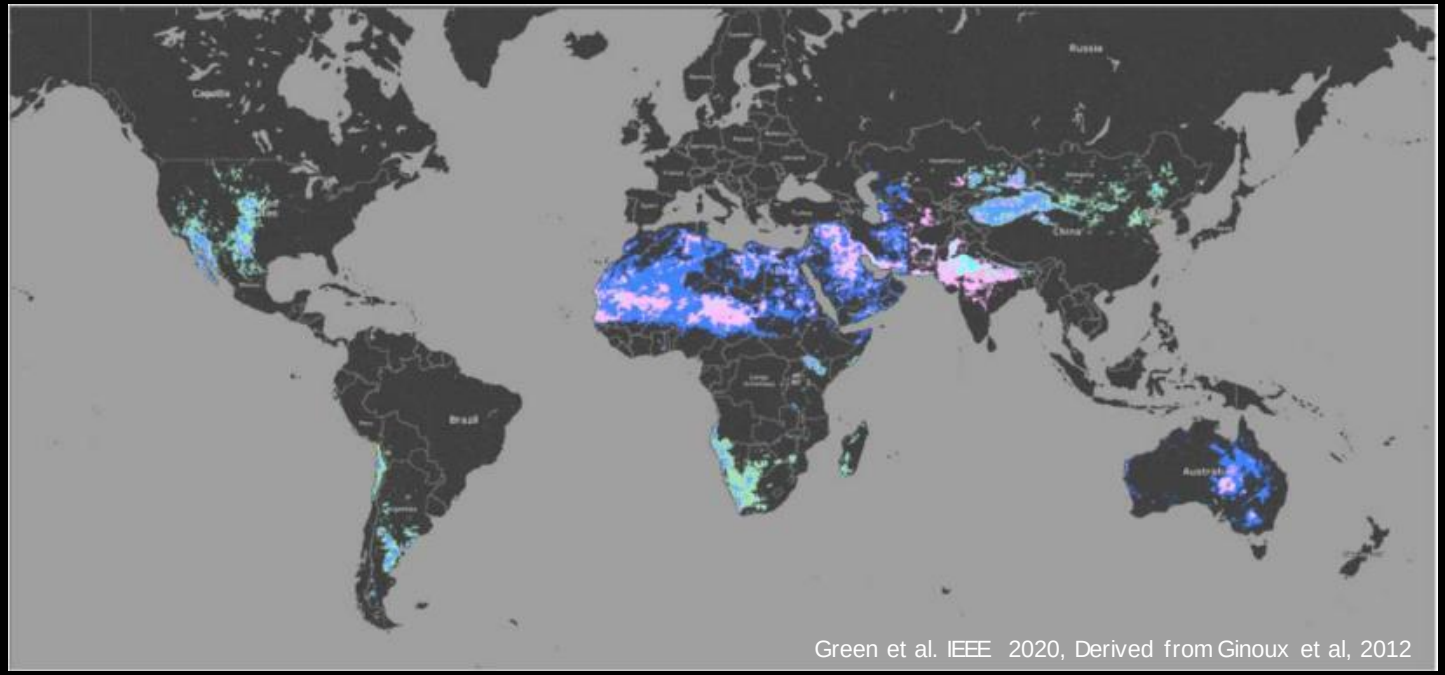
Calibrated Image Cube (60m)

Mineral Map



# EMIT Science Approach

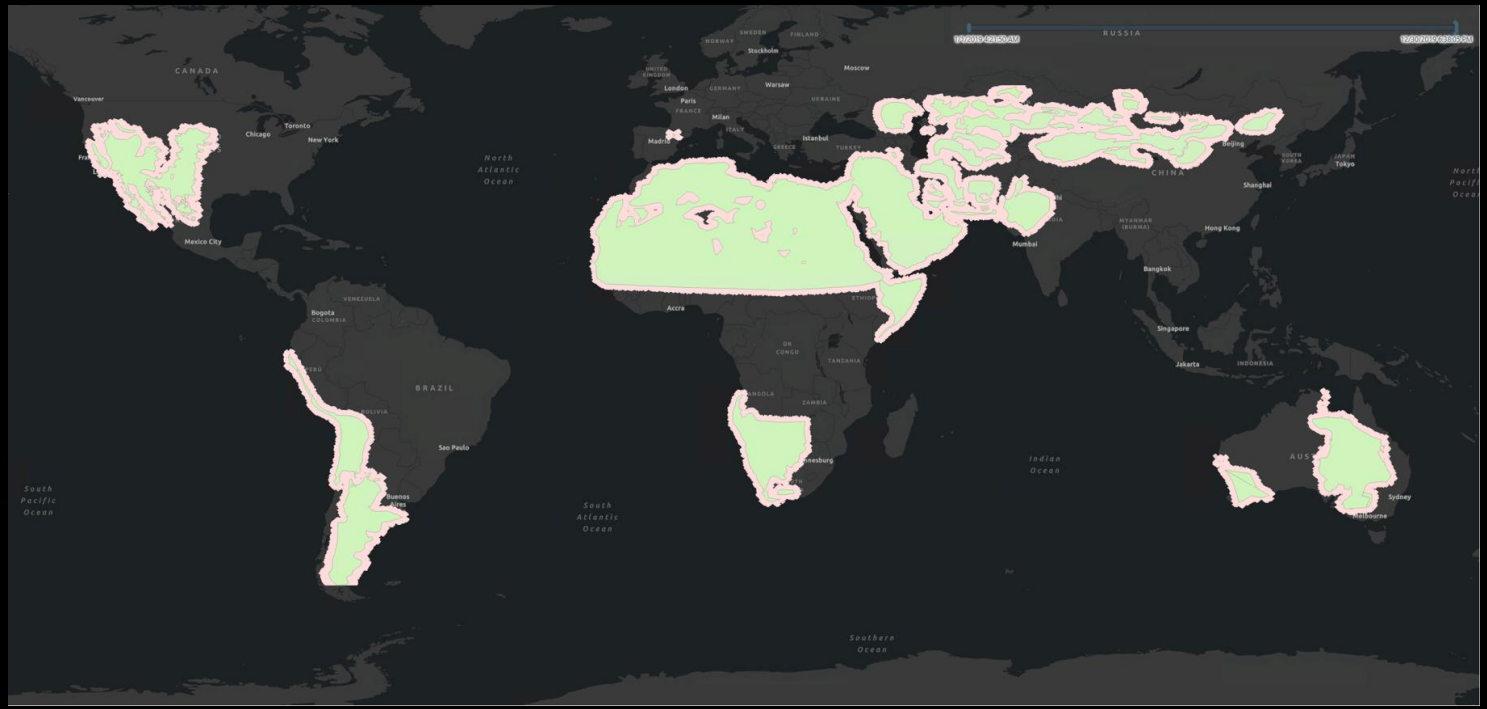
## Mapping surface minerology from dust emitting regions




Green et al. IEEE 2020, Derived from Ginoux et al, 2012

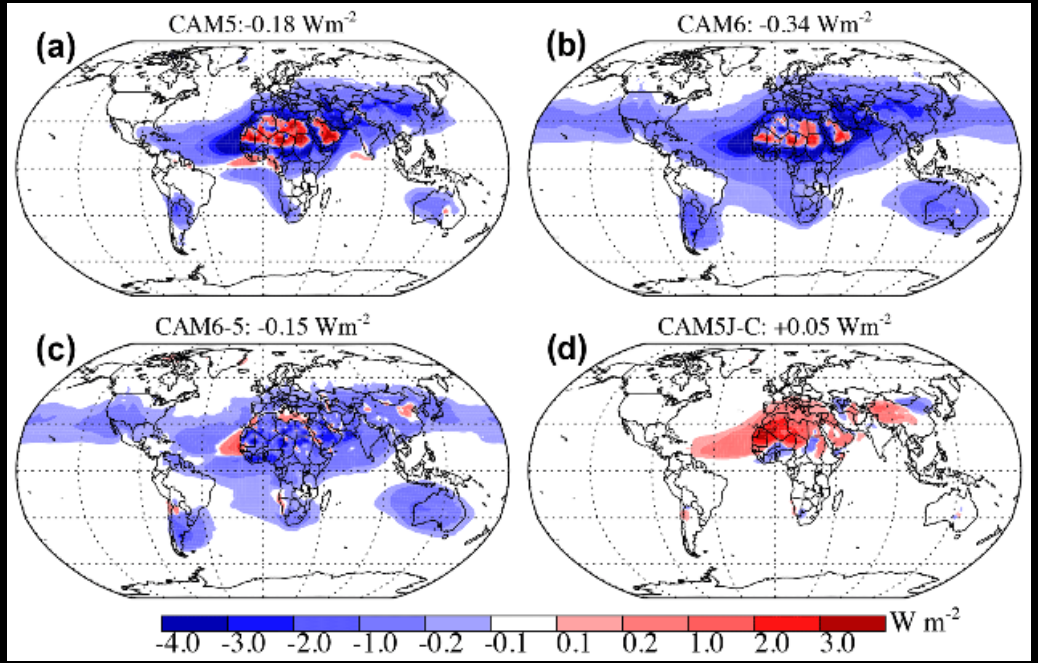
# EMIT Science Approach

## Targeting observations over dust emitting regions



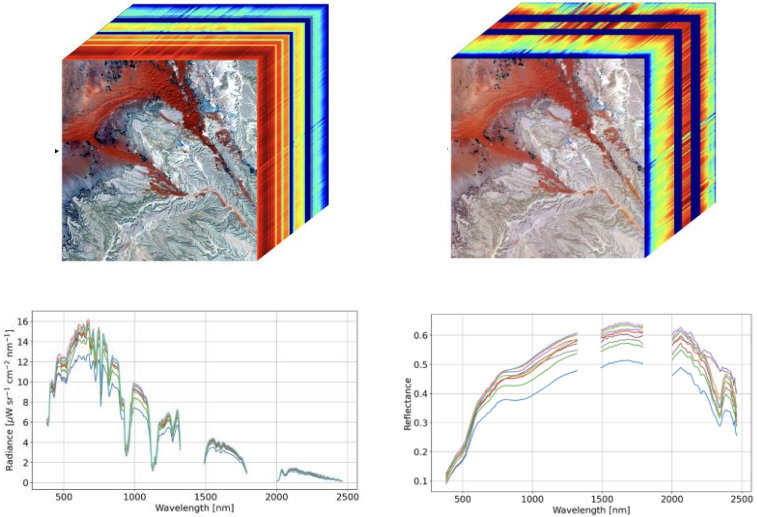
# EMIT Science Approach

## Integrate minerology into Earth System Models for forcing assessment



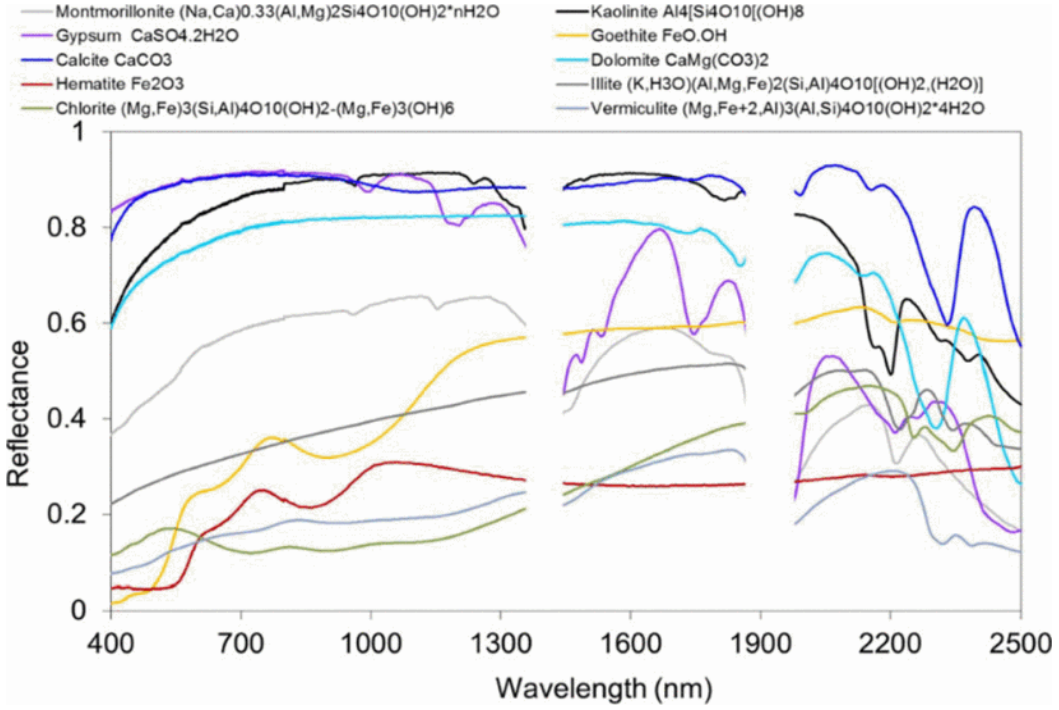
# EMIT Science Data Products

## Available on the LP DAAC!




**L1b: Radiance at Sensor**

**L2a: Surface Reflectance**



# EMIT Science Data Products

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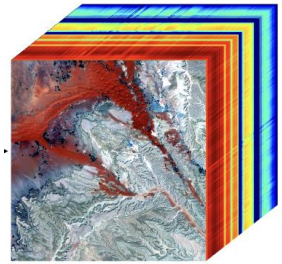
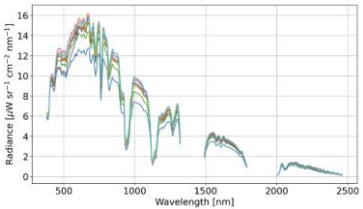
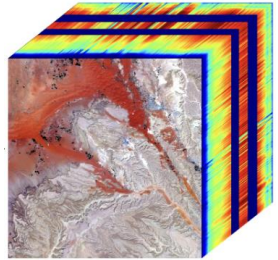
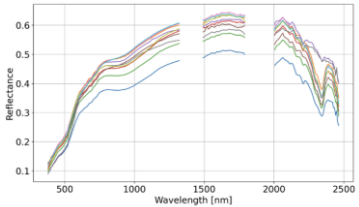




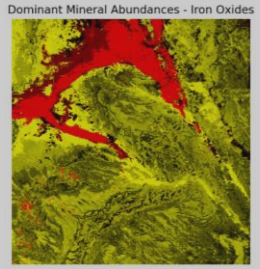

**L1b: Radiance at Sensor**



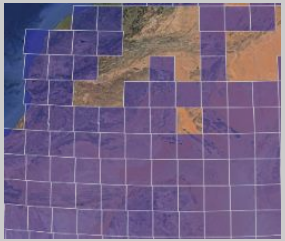



**L2a: Surface Reflectance**

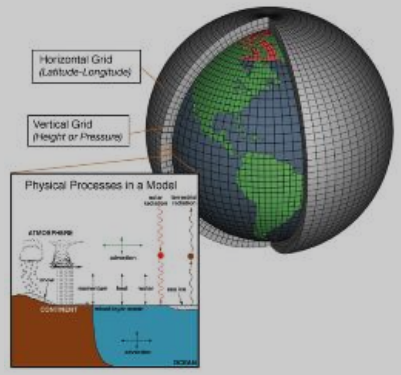
## Coming Soon!




**L2b: Mineral Maps**



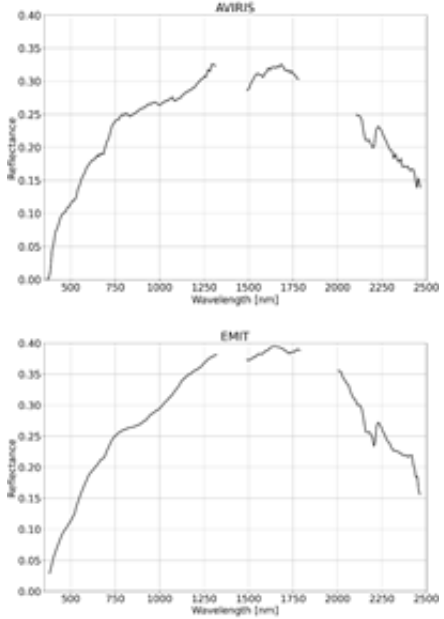
**L3: Aggregated Mineralogy**

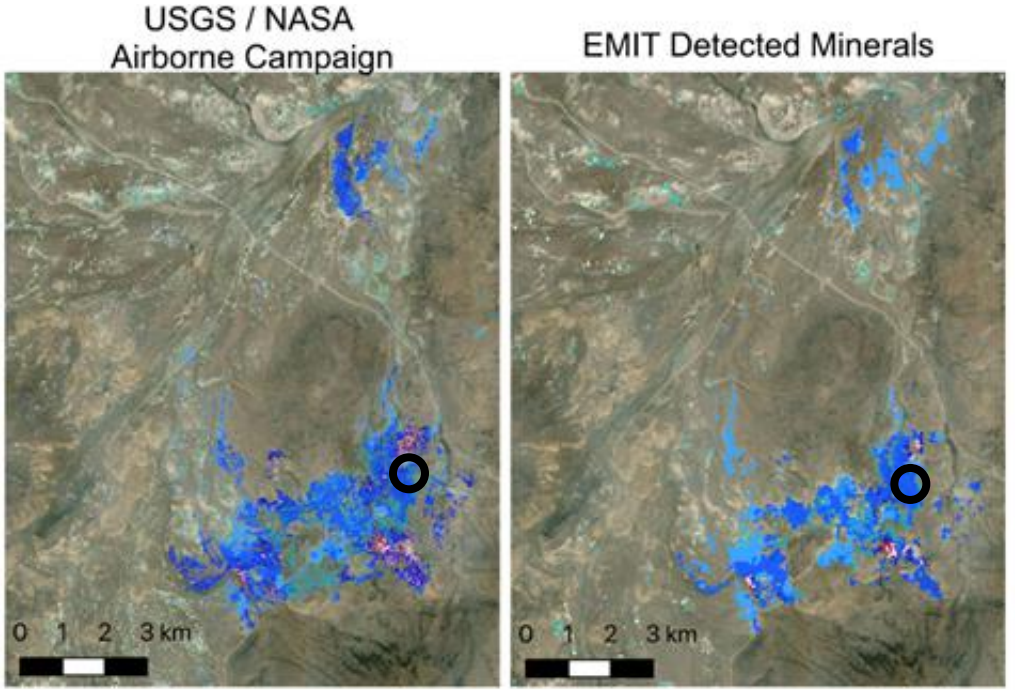



**L4: CESM, GISS Model Runs**

# EMIT Mineral Validation

## NASA AVIRIS Airborne and USGS Field Data




# EMIT Mineral Validation

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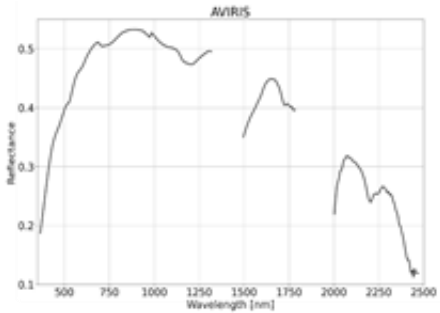
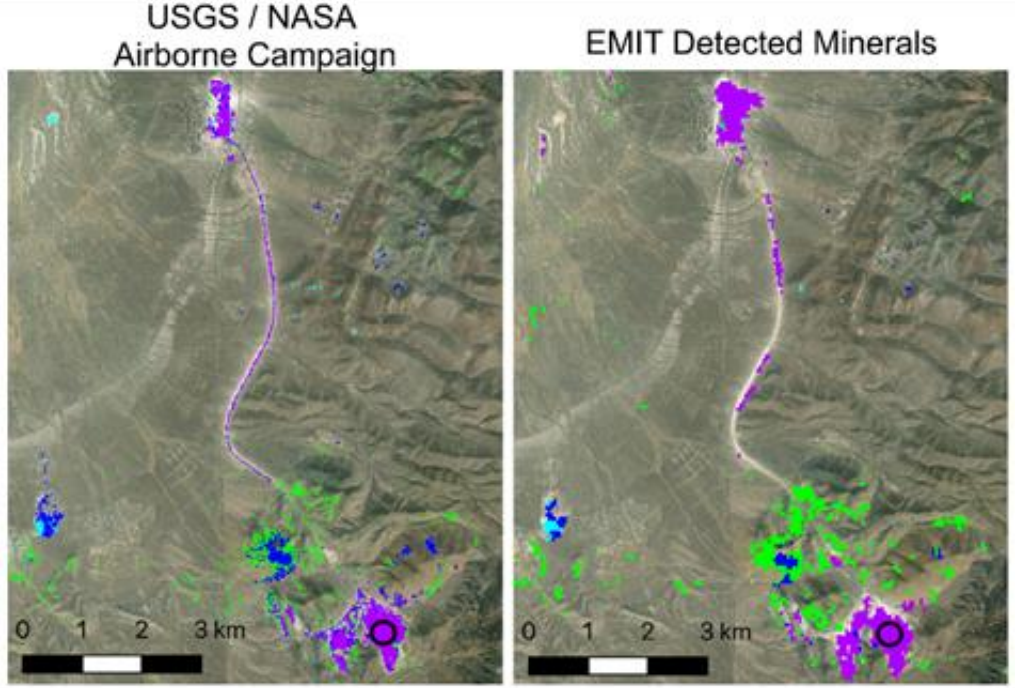


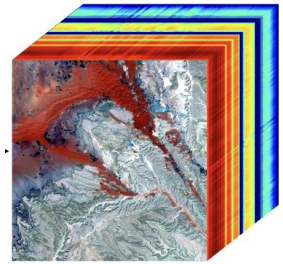



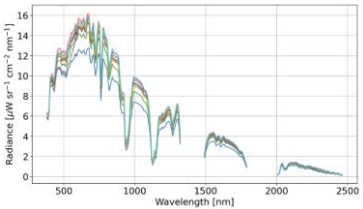

- Calcite
- Chlorite
- Dolomite
- Goethite
- Gypsum
- Hematite
- Illite & Muscovite
- Kaolinite
- Montmorillonite
- Vermiculite

# EMIT Coverage Map to Date

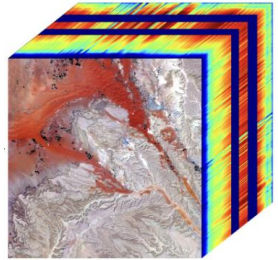
# EMIT Science Data Products

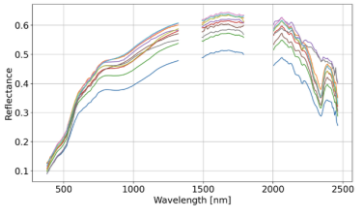
## Expanded Science & Application Potential – beyond EMIT's purview



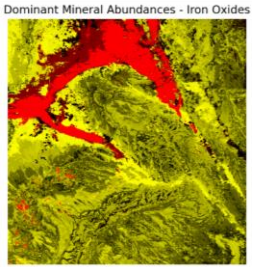



**L1b: Radiance at Sensor**

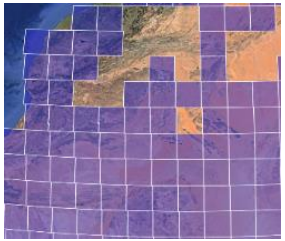




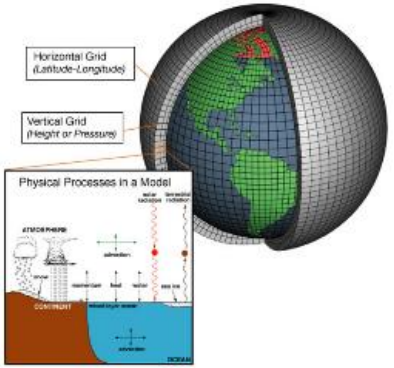

**L2a: Surface Reflectance**




**L2b: Mineral Maps**



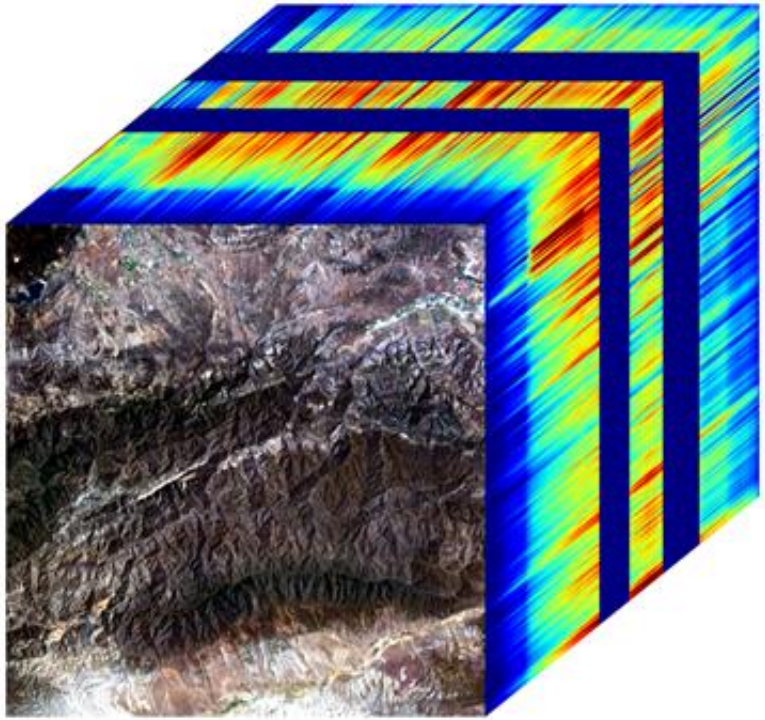
**L3: Aggregated Mineralogy**

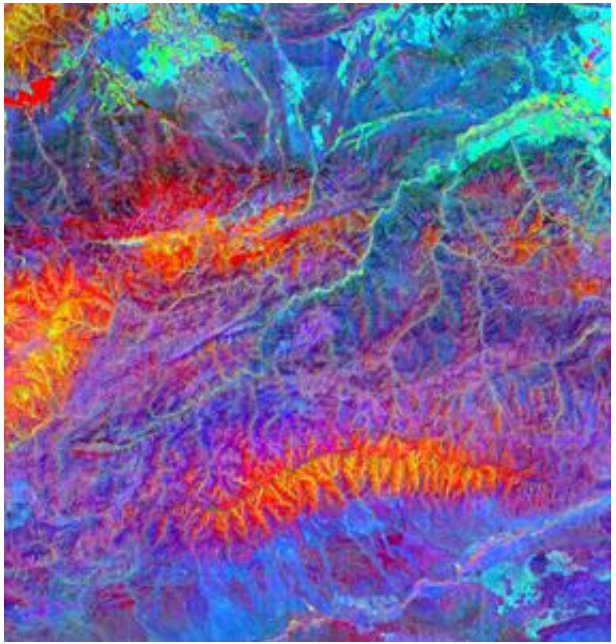



**L4: CESM, GISS Model Runs**

# Vegetation function and structure

## Santa Barbara County

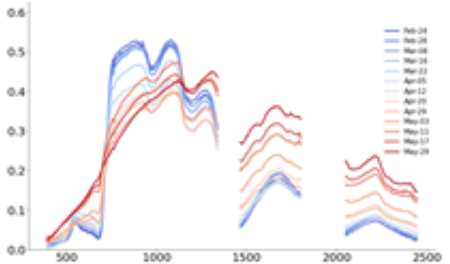




Example ecosystem spectral diversity

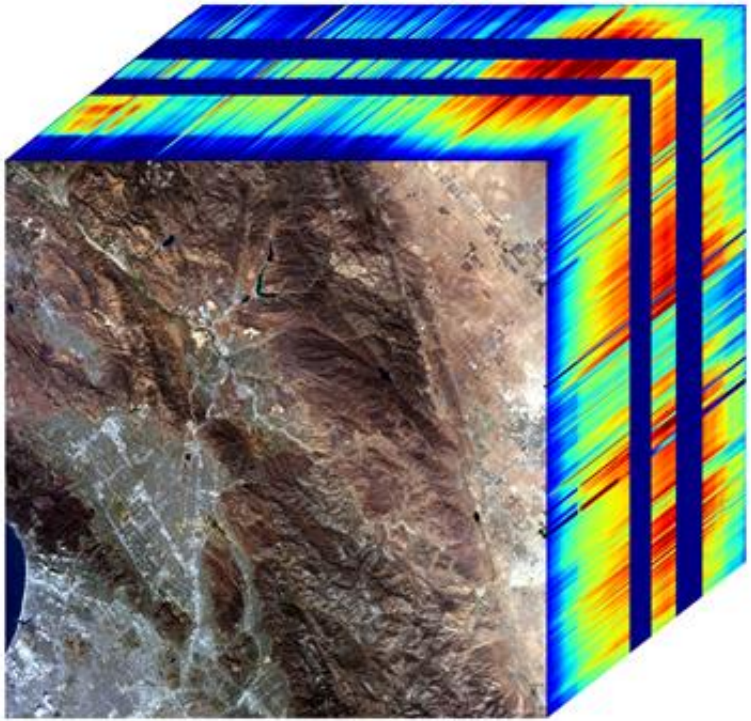
Foliar Trait Indices

- Leaf Mass per Area
- Leaf Water Content
- Nitrogen

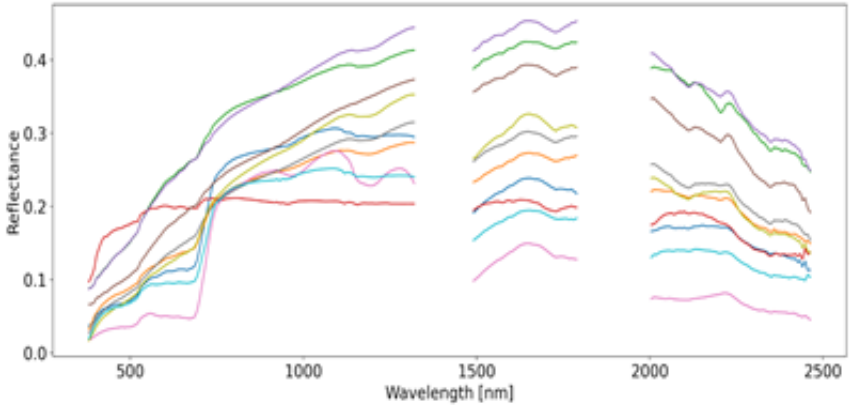


# Urban, Arid Land Ecosystems, and Agriculture

## Southern California

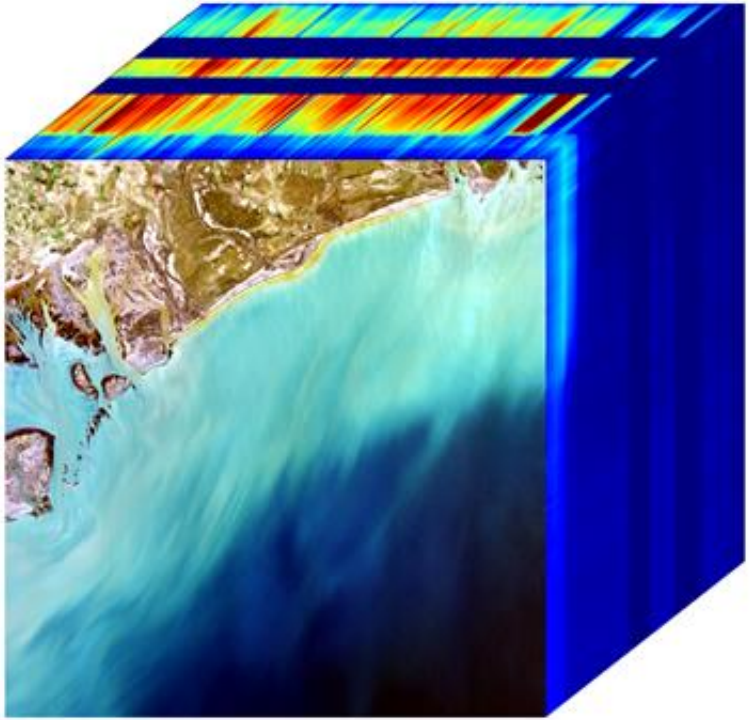


- Urban surface composition
  - Impervious surface
  - Vegetation and albedo (cool/heat)
- Solar panel mapping
- Dry land ecosystem (C. F. S.)
- Crop type, health, status

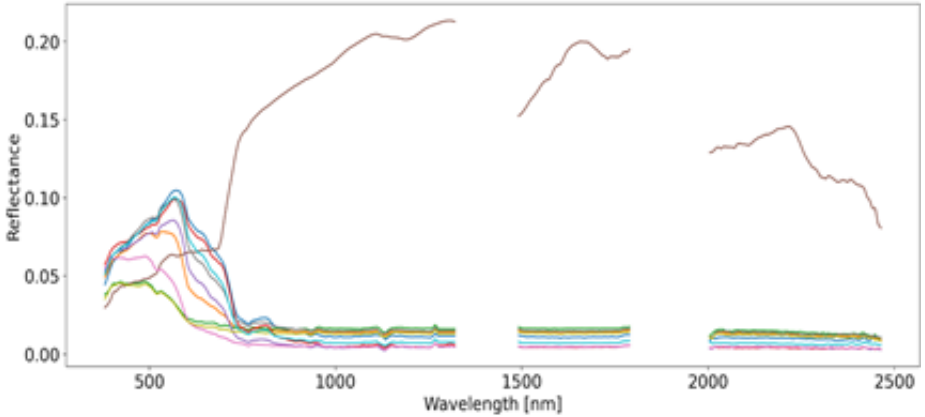


# Coastal Observation – Aquatic constituents

## Bahía Blanca, Argentina

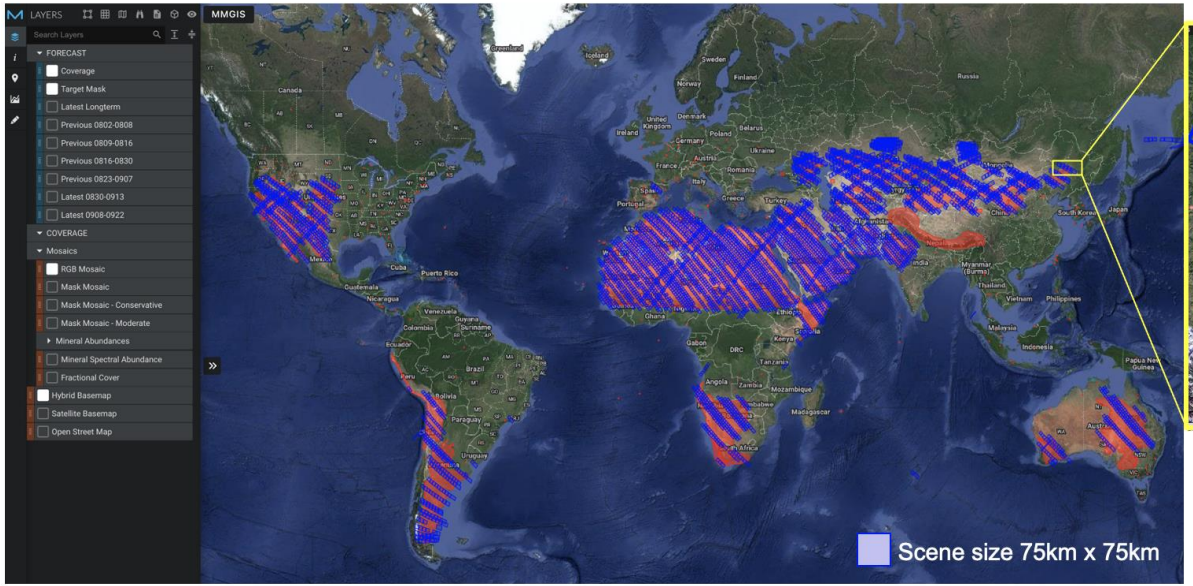


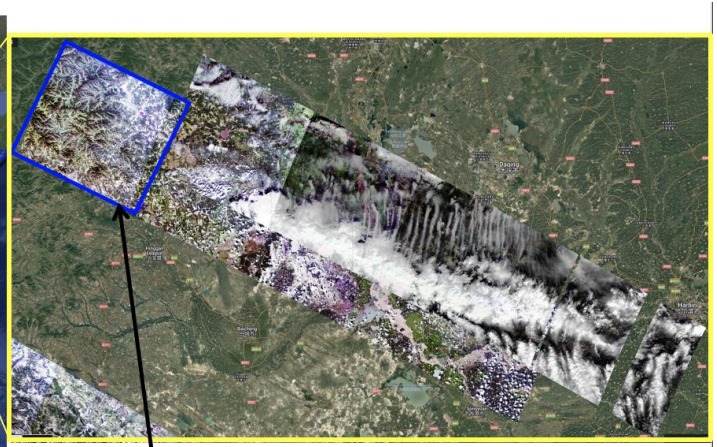
- Water constituents
- Algal blooms and types
- Sediment
- Shallow water benthic cover
- Coral environments
- Local coastal ecosystems



# Supporting open science and applications

## VISIONS: Portal supporting EMIT Data Visualization & Access

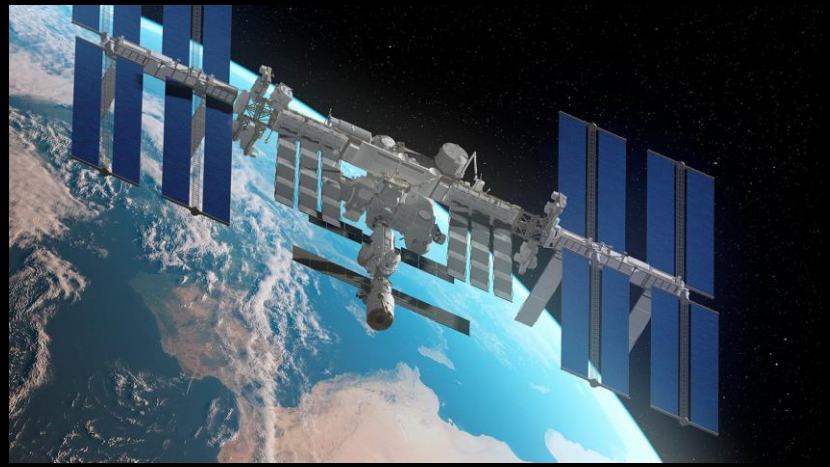



Web portal for rapid visualization with links to Land Processes DAAC for primary data access

# Join the EMIT community!

Science & Applications Team ROSES call now open



EMIT Community webinar, this Friday! Please join us

# Thank you! Questions?